
Principles of Environmental Restoration

Principle 4 – Managing Uncertainties

Principle 4

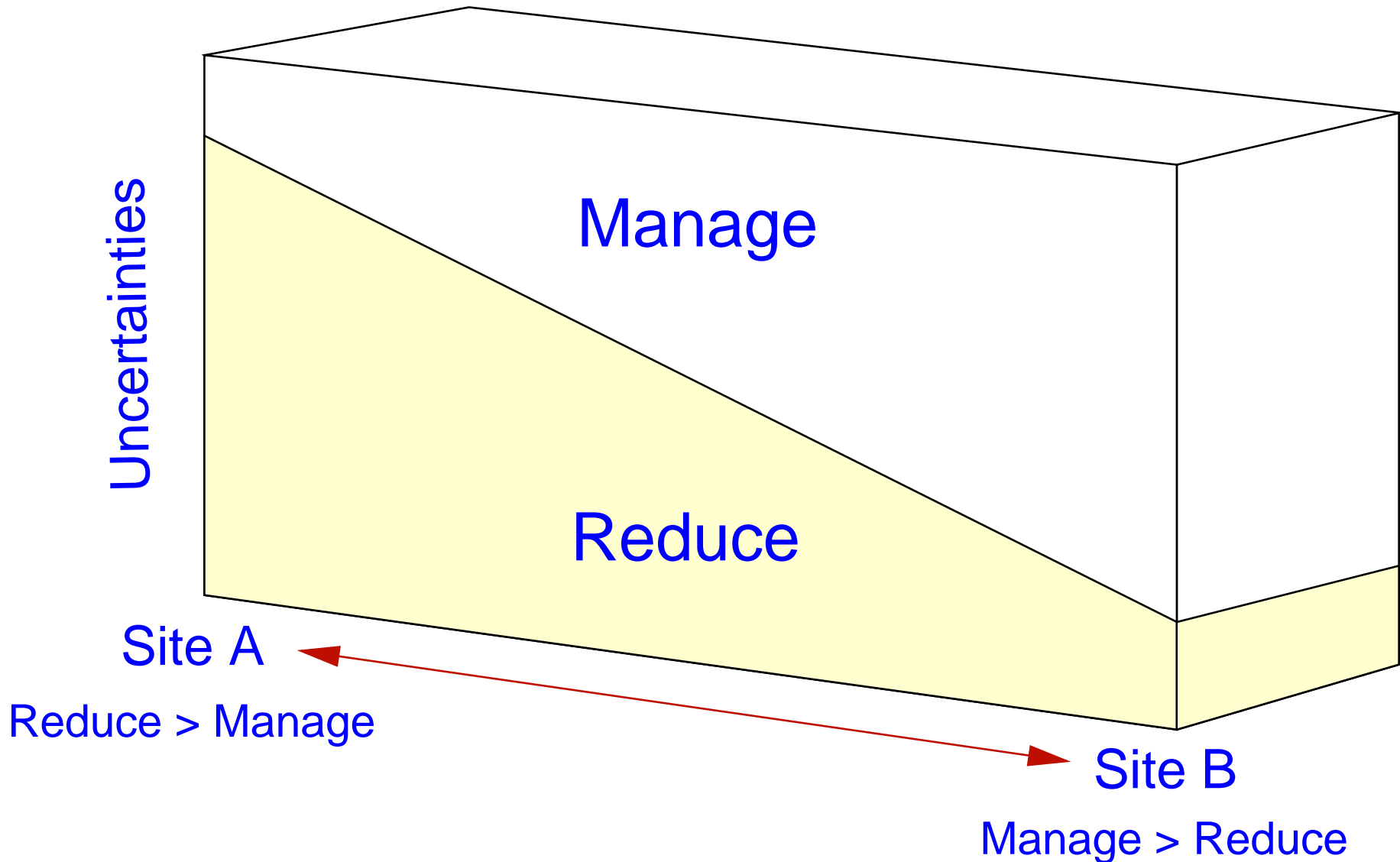
Uncertainties are inherent and will always need to be managed

- Session objectives:
 - Be able to identify different types of uncertainty
 - Be able to evaluate tradeoffs between managing uncertainties (contingency planning) and reducing uncertainties (additional data collection or evaluation)
 - Be able to develop an uncertainty management matrix
 - Understand different applications of uncertainty management matrix

Uncertainty management: key concepts

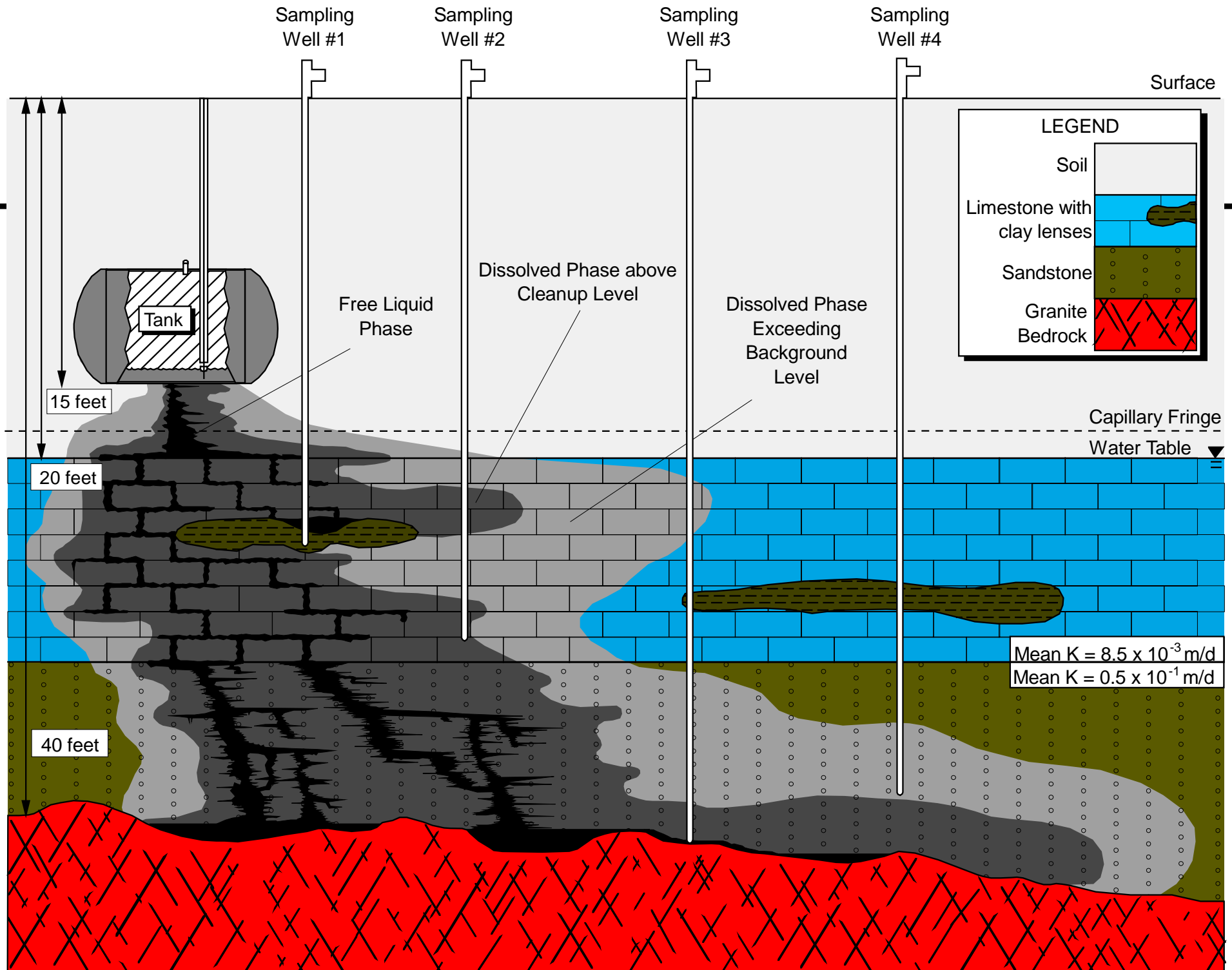
- Understanding the type of uncertainty and its impact on project decisions
- Evaluating tradeoffs between costs of data collection and "decisional benefits" obtained
- Achieving core team consensus to optimally balance:
 - reducing uncertainties through data collection and evaluation
 - "managing" uncertainty through contingency plans

The balance is site-specific



Sources of uncertainty

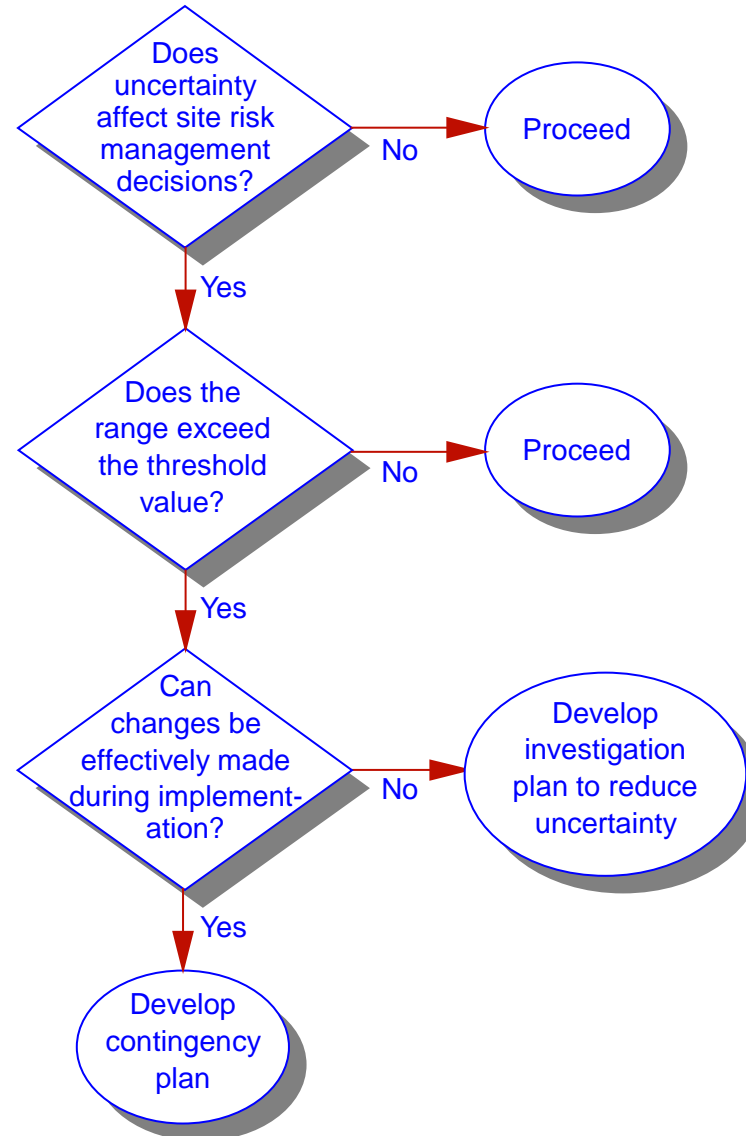
- Site characterization
- Technology selection
- Regulatory requirements
- Administrative processes
- Data analysis



Impact of uncertainties

- An uncertainty can be:
 - Insignificant to implementing the project and solving the problem
 - Significant and needs to be:
 - reduced prior to response (i.e., data need); or
 - managed during the response through contingency planning

Uncertainty management approach



Organizing uncertainty information

- Uncertainty can be characterized by the following information
 - Likely or expected condition
 - Reasonable deviation from the expected condition
 - Probability of occurrence
 - Time to respond
 - Potential impact on problem response/resolution
 - Monitoring plan
 - Contingency plan
- Uncertainty management changes emphasis from assessment to implementation

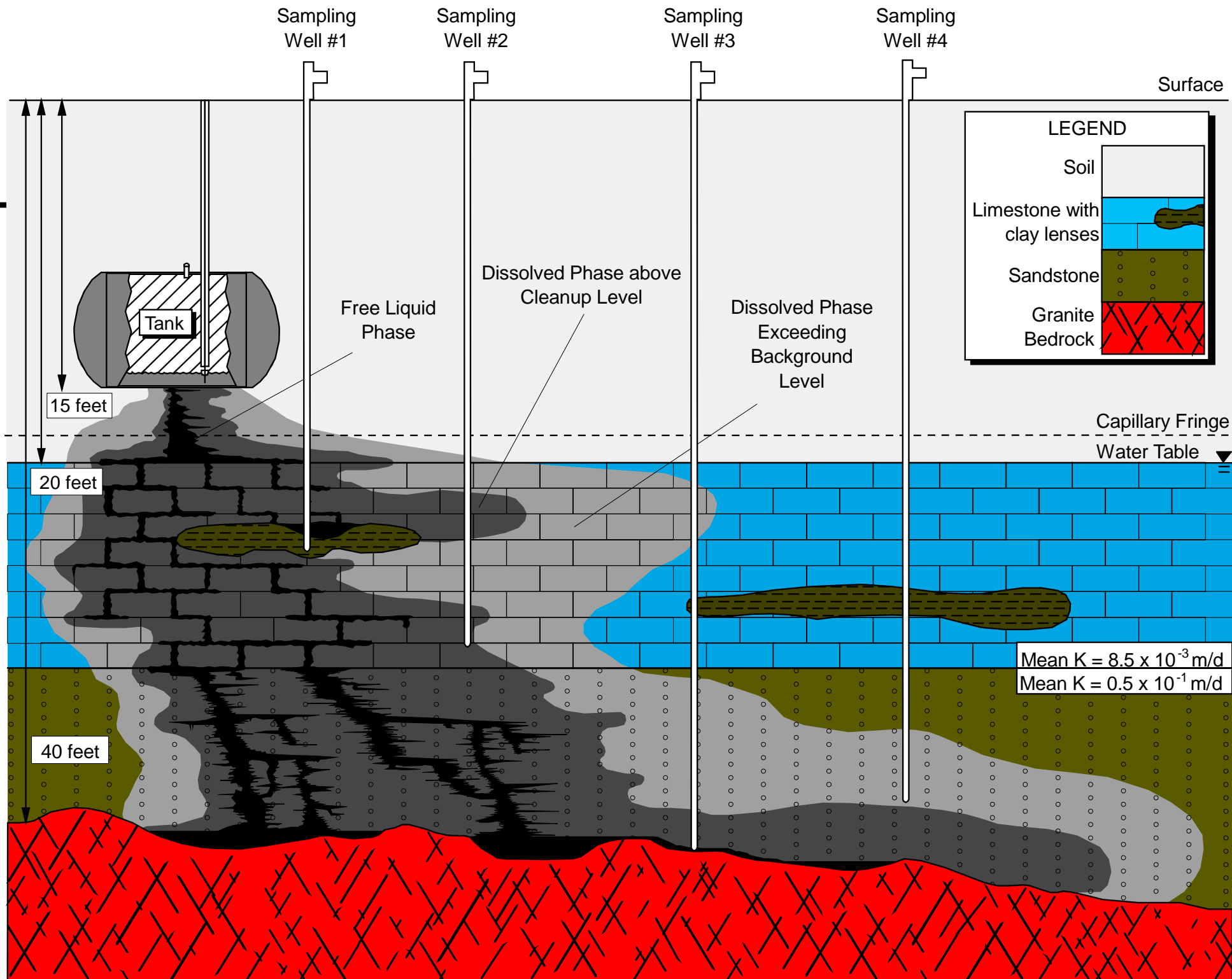
Categorizing impacts of uncertainties:

Example Decision Rule: If the underground tank is continuing to release TCE and Tc-99 to the environment, as indicated by liquid in the tank, remove tank

Probable Condition	Reasonable Deviation	Probability of Occurrence	Time to Respond	Potential Impact	Monitoring/ Investigation	Contingency Plan
Saturated soil conductivity expected to be 10E(-4) cm/s	Conductivity likely to range from 10E(-2) to 10E(-7) cm/s	High. (based on existing hydro-geologic data)	Long.	Low. May impact the drainage of rainwater if < 10E(-4) cm/s	N/A	Insignificant. No impact on likely response action.
Soil is expected to be stable (i.e., greater than Class C)	Soil may be unstable (i.e., slump slope < 50% or soil is less stable than Class C)	Low. (based on results of previous slump tests)	Short. (excavation face may sluff or cave in)	High. - Threat to worker safety - Could increase cost or delay schedule	Conduct visual inspections and additional slump tests	Significant. - Shore walls - Lay back excavation
Tank and its contents are expected to be low-level waste	Subtitle C debris management rule may be applicable (i.e., tank/contents could be hazardous or mixed waste)	Medium. (based on process knowledge)	Short. (to prevent excavation from being delayed)	High. - May delay excavation - May increase disposal costs and change handling requirements	Sample and analyze tank contents; compare results to regulatory criteria	Significant. Develop contingency plans for excavation, storage, and disposal of hazardous and mixed wastes; analyze cost impacts to ensure available funding.

Documenting uncertainty using decision rules

- Uncertainty: Is the tank a mixed low-level waste?
- If the tank is excavated and cannot be managed under RCRA debris regulations, then manage as a mixed waste; otherwise, manage as a low-level waste



In summary: What does categorizing uncertainties do?

- Forces explicit statements and consensus on uncertainties that may exist
- Establishes agreed to approaches to manage uncertainties
- Makes explicit the needs for data collection and/or contingency planning
- Helps document how the response will proceed

Small group exercise

- Review the materials for the pipe-in-trench example
- Identify uncertainties that exist
- Categorize the uncertainties in a matrix
- After 45 minutes, we will discuss the results

Pipe-in-trench problems

